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CME on CME interaction on January 17, 2005

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Abstract. On January 17, 2005 a complex radio event associated with an X3.8 SXR flare and two fast Halo CMEs (CME_1 & CME_2 henceforward) in close succession was observed. We present combined ARTEMIS–IV & WIND WAVES dynamic spectra which provide a complete view of the radio emission induced by shock waves and electron beams from the low corona to about 1 A.U. These are supplemented with data, from the Nançay Radioheliograph (NRH), GOES, EIT and LASCO for the study of the associated flare and CME activity.

Overview of the Event–Origin of the Radio Signatures

The complex event on January 17, 2005 was observed with the radio-spectrograph ARTEMIS-IV (Caroubalos & al 2001), the Nançay Radioheliograph (NRH Kerdraon & Delouis 1997), the WIND WAVES (Bougeret & al 1995) and the GOES, EIT and LASCO (Yashiro & al 2004). The most important radio bursts were two Type IIIGGs, two type II shocks and a long lasting type IV continuum which covered the ARTEMIS-IV/WIND/WAVES spectral range for hours; the EIT & NRH images indicate that they all originated near AR 720.

The GOES records report an X3.8 SXR flare from 06:59 UT to 10:07 UT, with maximum at 09:52 UT. The halo CME_1 was first recorded by LASCO at 09:30:05 UT; it was launched around 09:00:47 UT. The next CME_2 was first recorded at 09:54 UT and was launched around 09:38:25 UT; it was found to overtake CME_1 at about 12:45 UT at a height of approximate 37 solar radii. The interaction of two fast CMEs (the speed of CME_1 was 2094 km/sec & the speed of CME_2 2547 km/sec) is at variance with previous works (Gopalswamy & al 2001; Lehtinen & al 2005) that focus on fast–slow CME interaction.

The type II shocks were recorded by the WIND/WAVES; their extensions into the high frequencies are probably masked within the type IV continuum (Fig. 1). The frequency-time plots of CME_1 and CME_2 fronts were calculated from the LASCO Height vs. Time Plots and the Hybrid Coronal Density Model of Vrsnak & al (2004); they are well associated with the type II lanes and are thus interpreted both as *CME Bow Shocks*. As they approach each other (at about

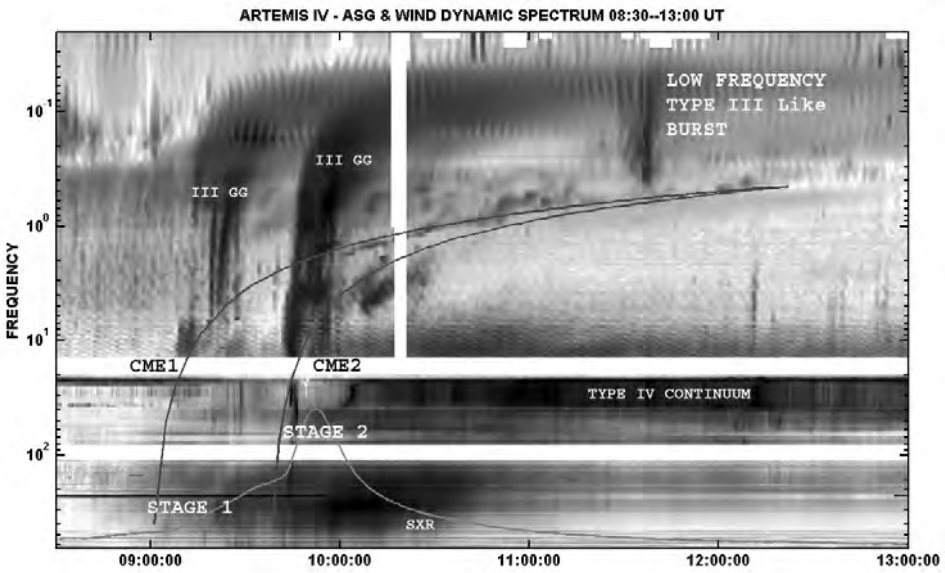

Figure 1. WIND & ARTEMIS IV Dynamic Spectrum, GOES SXR profile & the frequency–time plots of CME_1 & CME_2. The type IV continuum the two type III GG bursts, orginated at the two stages of the SXR flux rise, and the type III like burst at the convergence of the CME_1 & CME_2 fronts are duly annotated on the plot.

11:37 UT) a low frequency type III-like burst is recorded, probably tracing shock accelerated energetic electrons. The CME_1 & CME_2 lift–off is well associated, in time, with the two *stages* of the X3.8 SXR flux rise.

The two type III groups (08:41–09:42 UT), lastly, are also well associated with the two *stages* of the X3.8 SXR flux rise, therefore appears that their exciter electrons originated in the low corona during the impulsive phase of the flare.

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